

CLAIMS

What is claimed is:

1. A resonant optical power control device, comprising:

- a) a transmission fiber-optic waveguide for transmitting a propagating optical mode therethrough and having an evanescent optical coupling segment, an evanescent portion of the propagating optical mode extending beyond a surface of the evanescent optical coupling segment;
- b) a whispering-gallery-mode optical resonator for supporting a whispering-gallery optical mode, the whispering-gallery-mode optical resonator being positioned so that a portion of the whispering-gallery resonant optical mode at least partially spatially overlaps the evanescent portion of the propagating optical mode of the transmission fiber-optic waveguide, thereby evanescently optically coupling the transmission fiber-optic waveguide and the whispering-gallery-mode optical resonator;
- c) a modulator optical element positioned so that an evanescent portion of the whispering-gallery optical mode at least partially spatially overlaps the modulator optical element, thereby evanescently optically coupling the whispering-gallery-mode optical resonator to the modulator optical element; and
- d) a modulator control element, operatively coupled to the modulator optical element, for modulating, in response to an applied control signal, at least one of i) a level of optical power transfer through evanescent optical coupling of the whispering-gallery-mode optical resonator and the modulator optical element, ii) a level of optical loss of the modulator optical element, and iii) a resonant frequency of the modulator optical element, thereby enabling controlled modulation of a level of transmission of the propagating optical mode through the transmission fiber-optic waveguide when the propagating optical mode is substantially resonant with the whispering-gallery optical mode.

2. A method for modulating resonant optical power transmission, comprising the steps of:
launching a propagating optical mode into a transmission fiber-optic waveguide of a resonant optical power control device, the resonant optical power control device comprising

- a) the transmission fiber-optic waveguide, the transmission fiber-optic waveguide having an evanescent optical coupling segment, an evanescent portion of the propagating optical mode extending beyond a surface of the evanescent optical coupling segment,
 - b) a whispering-gallery-mode optical resonator for supporting a whispering-gallery resonant optical mode, the whispering-gallery-mode optical resonator being positioned so that a portion of the whispering-gallery resonant optical mode at least partially spatially overlaps the evanescent portion of the propagating optical mode of the transmission fiber-optic waveguide, thereby evanescently optically coupling the transmission fiber-optic waveguide and the whispering-gallery-mode optical resonator,
 - c) a modulator optical element positioned so that an evanescent portion of the whispering-gallery optical mode at least partially spatially overlaps the modulator optical element, thereby evanescently optically coupling the whispering-gallery-mode optical resonator to the modulator optical element, and
 - d) a modulator control element, operatively coupled to the modulator optical element, for modulating, in response to an applied control signal, at least one of i) a level of optical power transfer through evanescent optical coupling of the whispering-gallery-mode optical resonator and the modulator optical element, ii) a level of optical loss of the modulator optical element, and iii) a resonant frequency of the modulator optical element, thereby enabling controlled modulation of a level of transmission of the propagating optical mode through the transmission fiber-optic waveguide when the propagating optical mode is substantially resonant with the whispering-gallery optical mode; and
- applying a control signal to the modulator control element to modulate the level of transmission of the propagating optical mode through the transmission fiber-optic waveguide.
3. A method for fabricating a resonant optical power control device, comprising the steps of:
positioning a whispering-gallery-mode optical resonator relative to an evanescent optical coupling segment of a transmission fiber-optic waveguide so that a portion of a

1 whispering-gallery resonant optical mode supported by the resonator at least partially
2 spatially overlaps an evanescent portion of a propagating optical mode transmitted by
3 the transmission fiber-optic waveguide, thereby evanescently optically coupling the
4 transmission fiber-optic waveguide and the whispering-gallery-mode optical resonator,
5 the evanescent portion of the propagating optical mode extending from a surface of the
6 evanescent optical coupling segment of the transmission fiber-optic waveguide;
7 positioning a modulator optical element so that an evanescent portion of the whispering-
8 gallery optical mode at least partially spatially overlaps the modulator optical element,
9 thereby evanescently optically coupling the whispering-gallery-mode optical resonator
10 to the modulator optical element; and
11 operatively coupling to the modulator optical element a modulator control element for
12 modulating, in response to an applied control signal, at least one of i) a level of optical
13 power transfer through evanescent optical coupling of the whispering-gallery-mode
14 optical resonator and the modulator optical element, ii) a level of optical loss of the
15 modulator optical element, and iii) a resonant frequency of the modulator optical
16 element, thereby enabling controlled modulation of a level of transmission of the
17 propagating optical mode through the transmission fiber-optic waveguide when the
18 propagating optical mode is substantially resonant with the whispering-gallery optical
19 mode.
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